

E-3 Airborne Warning and Control System (AWACS)

Executive Summary

- The E-3 Airborne Warning and Control System (AWACS) provides airborne early warning, air surveillance, air battle management, and command and control without the beyond line-of-sight limitations inherent in ground-based air battle management systems.
- The Block 40/45 upgrade replaces the mission computing system on the E-3 with open-architecture, commercial off-the-shelf hardware including servers, and 15 mission crew interactive displays.
- The primary combat capability provided by the increased processing power of the Block 40/45 mission computing upgrade is to automatically fuse all onboard and off-board sensor inputs to provide a single track with a fused identification for each air, sea, and land entity using a multi-sensor integration algorithm.
- Block 40/45 is operationally effective. The modification provides many improvements for the operators, including automated tracking and identification. However, it did not provide the operators adequate control of the automated tracking capability. Additionally, it does not provide required enhancements to battle management capabilities, specifically the ability to automatically import data from the Air Operations Center to update the onboard database. It also does not provide Block 30/35 equivalent Link 16 datalink capabilities.
- Block 40/45 is not operationally suitable. During the IOT&E, the E-3 arrived on-station, on-time with both the radar and the Identification Friend or Foe (IFF) interrogation system functioning only one-third of the time. Operator and maintainer training were deficient and repair times exceeded requirements. Although Block 40/45 does not currently meet several key suitability requirements, Block 40/45 hardware is more reliable than the aging Block 30/35 equipment it replaces. Even when software failures are included, Block 40/45 is still more reliable than Block 30/35.

System

- AWACS is built on a Boeing 707 airframe. A surveillance radar and IFF system are located in the rotodome above the airframe. An Electronic Support Measures system has antennas on the cheeks of the airframe, under the nose, and in the tail. The E-3 has 13 Ultra High Frequency radios, 4 Very High Frequency radios, and 3 High Frequency radios.
- The Block 40/45 upgrade replaces the mission computing system on the E-3 with open-architecture, commercial off-the-shelf hardware including servers, and 15 mission crew interactive displays. The mission computing software program is replaced with a set of local area networked, open-architecture programs. The human-computer interface



- is built on the Windows® operating system and licenses the Raytheon Solipsys© Tactical Display Framework.
- The Block 40/45 mission computing upgrade provides the capability to automatically fuse all onboard and off-board sensor inputs to provide a single track for each air, sea, and land entity using a multi-sensor integration algorithm. The upgrade is also intended to provide:
 - An update to the E-3 AWACS Link 16 and satellite communications capabilities
 - Software to automatically refresh the onboard database
 - An updated mission system health monitoring tool
 - Improved interfaces and controls of the onboard passive Electronic Support Measure system
 - Improved mission planning and post mission processing capabilities
- The first six Block 40/45 E-3s are planned to have three different mission computing configurations. The Air Force plans to use the configuration of the seventh Block 40/45 E-3 to upgrade the next 11 jets.
- Block 40/45 requires several new ground support systems including the mission planning system, which the contractor delivered with the first upgraded aircraft. The contractor will deliver a deployable mission planning system before Initial Operational Capability in December 2013, in addition to trainers for maintenance personnel and mission crew.

Mission

The Air Component Commanders use AWACS-equipped units to:

- Provide early warning, air surveillance, air battle management, and beyond line-of-sight capabilities
- Provide command and control of offensive and defensive counterair and countersea operations, and strike missions

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including dynamic targeting, close-air support, suppression of enemy air defenses, and strategic attacks

- Manage air refueling operations, combat search and rescue missions, and special operations missions

Major Contractor

The Boeing Company – Seattle, Washington

Activity

- During FY11, Boeing conducted developmental test and evaluation (DT&E) using the first production Block 40/45 E-3. Air Force Joint Task Force personnel were present at all qualification test events and had signature authority for pass/fail determination. This contractor-conducted DT&E consisted of seven flights from Boeing Field, Seattle, Washington. The focus of the final phase of DT&E was to verify changes made to the production system after the Air Force Operational Test and Evaluation Center (AFOTEC) published the 2007 Operational Assessment in support of the Low-Rate Initial Production decision.
- AFOTEC conducted a 24-flight IOT&E operating from the E-3 main operating base, Tinker AFB, Oklahoma City, Oklahoma, between March and June 2012. The IOT&E was conducted in accordance with the DOT&E-approved test plan. While there were no overnight deployments, the two operational Block 40/45 E-3s participated in several large force exercises. The Block 40/45 IOT&E included flights working with assets from all four Services in training areas on both coasts as well as over land.

Assessment

- Block 40/45 testing was adequate to support an evaluation of operational effectiveness and suitability.
- Block 40/45 was not ready to enter IOT&E. Contractor-conducted DT&E focused on specification compliance verification in lieu of a government-conducted DT&E, which could have assessed risks to a successful IOT&E outcome.
- Training was not representative of the syllabus intended for maintainers and aircrews. Operator and maintainer training simulators were not ready for IOT&E. The deployable mission planning system was also not available for the IOT&E. Additionally, documentation for both operators and maintainers was incomplete.
- Several Block 40/45 capabilities, including the mission planning system and start-up checklist, were never tested in DT&E. The Program Office never documented workarounds for use by aircrews during contractor DT&E, nor did they modify the system design to reflect changes in interoperability standards during Block 40/45 development.
- Block 40/45 is operationally effective. It provides some improvements for the operators, but not all the required enhancements. Block 40/45 provided automated tracking and combat identification, but did not provide the operators adequate control of the automated tracking capability. The crews were able to accomplish their battle management

command and control missions throughout the IOT&E; however, Block 40/45 did not adequately provide the required capability to receive free-text data from the Air Operations Center and automatically import the data into onboard databases.

- Block 40/45 does not provide equivalent Link 16 capabilities to Block 30/35, which it replaces. AFOTEC discovered several interoperability deficiencies during the IOT&E. Many of the tactical datalink deficiencies were caused by the Air Force not modifying the system design to reflect changes in interoperability standards during Block 40/45 development. The satellite communications terminal did not provide an operationally useful capability to receive digital information.
- Block 40/45 is not operationally suitable. During the IOT&E, the Block 40/45 E-3 arrived on-station, on-time, with both the radar and IFF interrogation system functioning only one-third of the time. Block 40/45 system deficiencies caused half the missed on-station times, while legacy system deficiencies caused the other half.
- Block 40/45 demonstrated poor reliability. The Mean Time Between Critical Failure was 9 hours, which is significantly less than the threshold of 2,500 hours. Two-thirds of all critical failures occurred while starting the mission computing system. However, the Block 40/45 hardware is already more reliable than the Block 30/35 hardware it replaces (72-hour vice 4.6-hour Mean Time Between Unscheduled Maintenance (MTBUM)).
- When considering the addition of software failures and the reduction of Block 40/45 MTBUM, Block 40/45 is still more reliable than Block 30/35.
- Two ground repair actions were incomplete at the end of the IOT&E. One open repair action was for a legacy Block 30/35 part. The second open repair action was for a Block 40/45 part that was either not ordered or not provided for 14 days.

Recommendations

- Status of Previous Recommendations. This is the first annual report for this program.
- FY12 Recommendations. The Air Force should:
 1. Incorporate the most current datalink message standards into Block 40/45. This will allow Block 40/45 to have a datalink capability equivalent to the fielded legacy Block 30/35 AWACS fleet.
 2. Complete and update aircrew and maintenance checklists and technical orders to address the new failure modes discovered during IOT&E.

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3. Modify the mission computing software and refine technician training to reduce the incidence of induced critical failures during Block 40/45 mission computing startup.
4. Develop software modifications to improve aircrew ability to control the automated tracking capability.
5. Review and update the planned training syllabus for both aircrew and maintenance personnel with information learned during the IOT&E.
6. Conduct FOT&E of Block 40/45 using the first Block 40/45 configuration that will be installed on more than two aircraft. The FOT&E should include an operationally representative deployment in a stressful tracking and combat identification environment.

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